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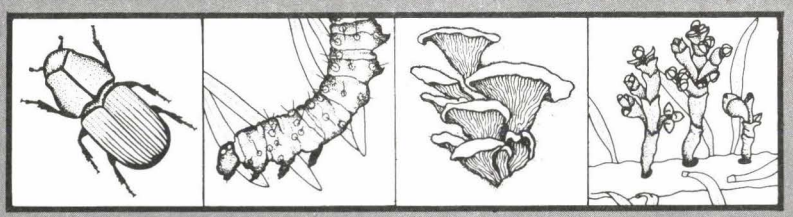

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EVALUATION OF ROOT DISEASES ON THE DUCHARME LOGGING UNIT, FLATHEAD INDIAN RESERVATION

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ABSTRACT

A root disease evaluation was completed for the Ducharme logging unit near the southeast corner of Flathead Lake. Extensive root disease was found on Douglas-fir throughout the unit. The major pathogen on the site was Armillaria mellea. Black stain (Verticicladiella sp.) was isolated from one tree which was also infected with A. mellea. Bark beetles were not associated with mortality in the unit. Several management approaches to reduce disease losses are discussed.

INTRODUCTION

Root diseases are common within temperate conifer ecosystems. These important diseases are widespread throughout northern Idaho and western Montana, especially west of the Continental Divide (9). They seriously impact management direction and influence production alternatives in certain areas.

Root diseases enhance tree mortality and often reduce growth (1). Insects, particularly bark beetles, may attack and kill root-diseased trees (4, 6, 8). Trees with root disease usually occur in groups with mortality spread over many years. Trees within root disease centers display several levels of decline with recently infected trees on the periphery and older mortality in the center.

A large area of suspected root disease was recently located on the Flathead Indian Reservation, Montana, near the southeast corner of Flathead Lake by Steve Haglund, Bureau of Indian Affairs forester. He subsequently requested a biological evaluation of the area. Affected trees were located within the Ducharme logging unit in the SW1/4, SE1/4 of Sec. 4, T. 22 N., R. 19 W. (figure 1).

METHODS

The Ducharme logging unit was evaluated for root diseases on December 29, 1980. Root collar examinations were made on trees displaying crown symptoms. In addition, root systems of 20 trees were excavated with a D-6 bulldozer. Trees selected for excavation were located along a strip through disease centers. Some trees without disease symptoms were included in the sample.

Samples of roots containing black stain were transported to the laboratory where isolations were made. Fungi emerging from wood samples were identified and maintained on potato dextrose agar slants.

RESULTS AND DISCUSSION

Extensive root disease was found throughout the Ducharme logging unit. Trees with advanced

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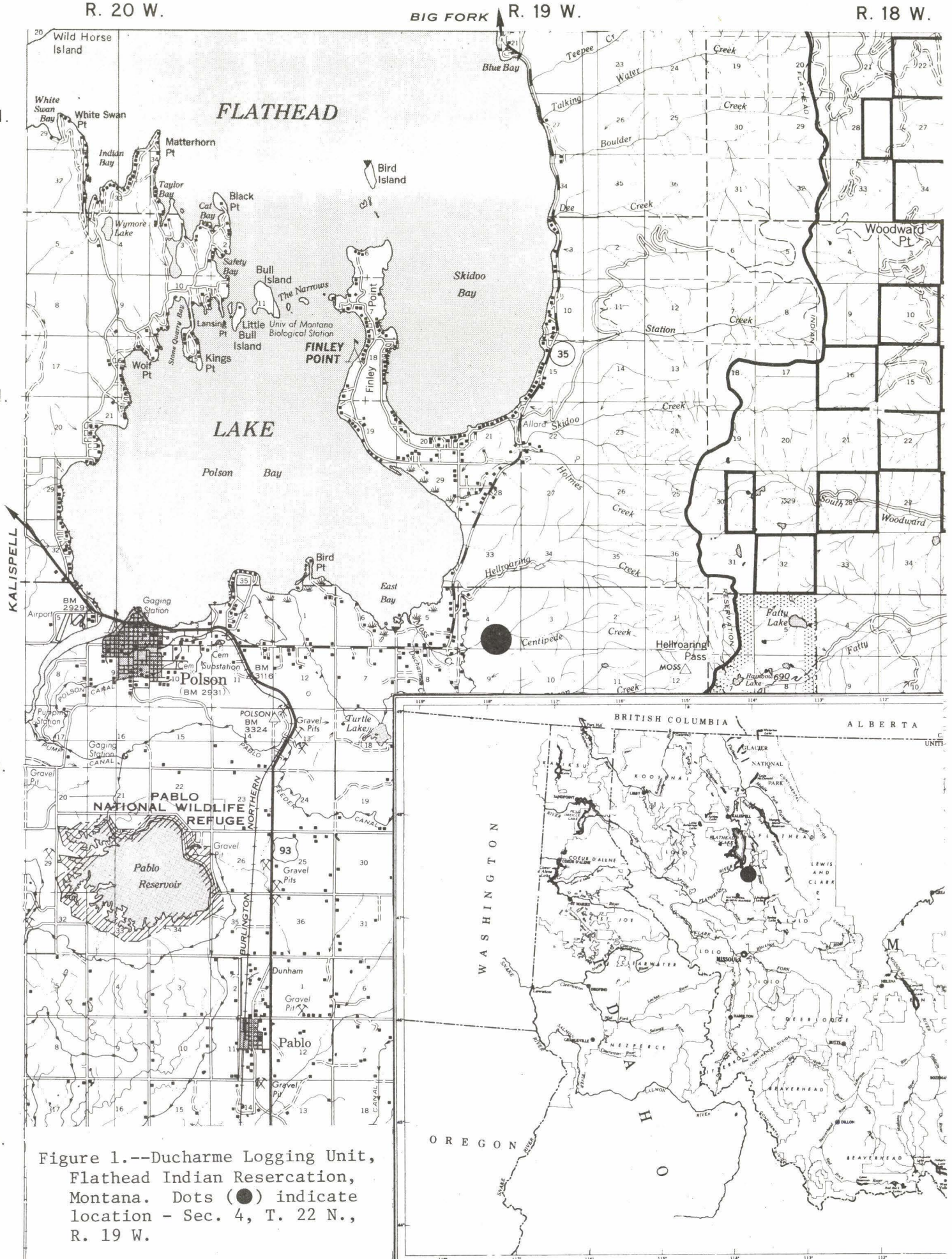

Figure 1.--Ducharme Logging Unit, Flathead Indian Resercation, Montana. Dots (●) indicate location - Sec. 4, T. 22 N., R. 19 W.

root disease had typical crown symptoms consisting of thin, chlorotic foliage and excessive cone crops. Numerous disease centers were present, many of which had coalesced to form large understocked areas several acres in size. Douglas-fir (Pseudotsuga menziesii Franco) was the major tree species affected; ponderosa pine (Pinus ponderosa Laws.) and western larch (Larix occidentalis Nutt.) did not show signs of infection. Although most Douglas-fir were killed within disease centers, some individual trees did not display disease symptoms and therefore may have escaped infection.

The most readily identified pathogen on the site was Armillaria mellea (Vahl. ex Fr.). This fungus produced large mycelial fans in the cambium region around the root collar of infected trees. Profuse resinosis on the outside of the bark often accompanied fan production.

Trees with thin, chlorotic crowns always had extensive root decay caused by A. mellea. The fungus had nearly girdled trees by the time decline symptoms began to appear. Trees without foliage symptoms also often had A. mellea decay in their roots. However, such decay was usually localized in a small portion of the root system. Patterns of declining tree and root colonization indicated that A. mellea probably spread from tree to tree via root contacts.

The other root pathogen found within the unit was Verticicladiella sp., which may be the imperfect state of Ceratocystis wageneri Goheen and Cobb, cause of black stain root disease (3). This fungus was isolated from the roots of a Douglas-fir tree which lacked foliar symptoms and was located on the edge of a large disease center. Armillaria mellea was also located on the roots of this tree.

Verticicladiella was isolated from small (5-10 mm diameter) roots with streaks of brown-black stain in the xylem. The same fungus was also associated with red stain near the pith region of some small roots. Thin sections of stained wood revealed brown fungal hyphae colonizing xylem tracheids; transverse ray tracheids and parenchyma were not penetrated.

Armillaria and black stain root disease have been associated together with Douglas-fir mortality in several other locations in western Montana. Trees with both pathogens were found on the St. Mary's logging unit, Flathead Indian Reservation (2) (approximately 80 km south of the Ducharme unit) the Ninemile Ranger District, Lolo National Forest, and on Champion International land east of Missoula. At these locations, black stain was found on small roots distal from the root collar on trees with slight or no crown symptoms. Some of these trees were also infected with A. mellea. Black stain was not detected at the root collar of infected trees. Observations indicate that black stain apparently is replaced by and may be an important predisposing agent of A. mellea.

Although bark beetles often kill trees weakened by root disease (4, 8), there was no evidence of insects being associated with tree mortality at the Ducharme unit. Site factors, relative host susceptibility, or aggressiveness of pathogens may account for the extensive tree mortality caused by root diseases alone.

The relative low level of black stain at the Ducharme unit may be reflected in patterns of tree mortality within disease centers. Where black stain is extensive, very few live Douglas-fir occur within infection centers (2). On the other hand, numerous large Douglas-firs apparently escaped or resisted attack by A. mellea in the Ducharme unit. This may indicate that black stain plays an important role in predisposition of trees to A. mellea. Extent of predisposition may affect mortality and disease center spread rates.

Forest managers plan to evaluate three procedures for reducing root disease losses within the Ducharme unit. The treatments include: (1) clearcut harvest and regenerate by planting tolerant species (ponderosa pine, lodgepole pine (Pinus contorta Dougl.) and western larch), (2) seed tree harvest leaving residual pine and larch to regenerate the site, and (3) high risk harvest removing recently killed trees and those with advanced disease symptoms.

This evaluation should help answer questions regarding:

1. Fate of pine and larch regeneration in the clearcut and replant treatment. Although previous observations (5, 7) indicate that pine regeneration is killed by A. mellea after a few years when roots contact residual soil inoculum, we are unsure whether pine will continue to tolerate the disease at the Ducharme unit. If losses do occur we need to know if stocking levels will be reduced enough to affect yields.

2. Fate of residual pine and larch seed trees and extent and rate of Douglas-fir reinvasion. Seed trees need to resist root disease until a new crop of tolerant trees is established. However, reinvasion by Douglas-fir may perpetuate disease problems by providing susceptible trees.

3. Fate of residual trees in high-risk tree removal. Harvesting high-risk trees is a common disease control strategy. However, we are unsure whether this enhances or reduces subsequent losses to residual trees. Fungi may use freshly cut stumps to build up inoculum to successfully attack surrounding trees (5, 7). On the other hand, with reduced competition, vigor of residual trees may improve enough to resist infection.

Many questions remain concerning behavior of root diseases in western Montana. Research is urgently needed on aspects of disease etiology, roles of different fungi in disease complexes, silvicultural options for reducing impact, effects of site factors on disease severity, and development of risk rating systems for use by foresters.

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